DOCUMENT RESUME

ED 254 717 CE 040 993

TITLE Millwright Apprenticeship. Related Training Modules. 3.1-3.4 Computers.
INSTITUTION Lane Community Coll., Eugene, Oreg.
SPONS AGENCY Oregon State Dept. of Education, Salem.
PUB DATE [82]
NOTE 82p.; For related documents, see CE 040 991-041 007. Many of the modules are duplicated in CE 040 967 and CE 040 971.
PUB TYPE Guides - Classroom Use - Materials (For Learner) (051)

EDRS PRICE MF01/PC04 Plus Postage.
DESCRIPTORS *Apprenticeships; Behavioral Objectives; *Computer Literacy; Computer Software; Job Skills; Job Training; Learning Modules; Machine Tools; Postsecondary Education; Power Technology; *Trade and Industrial Education
IDENTIFIERS *Millwrights

ABSTRACT

This packet, part of the instructional materials for the Oregon apprenticeship program for millwright training, contains four modules covering computers. The modules provide information on the following topics: digital language, digital logic, computer overview, and computer software. Each module consists of a goal, performance indicators, directions, learning activities, vocabulary, information sheets illustrated with line drawings, self-assessment test(s) with answers, and a post-assessment test. (KC)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED2547717

APPRENTICESHIP

MILLWRIGHT

RELATED TRAINING MODULES

3.1 - 3.4 COMPUTERS

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

S. J. Case

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

CE040993

STATEMENT OF ASSURANCE

IT IS THE POLICY OF THE OREGON DEPARTMENT OF EDUCATION THAT NO PERSON BE SUBJECTED TO DISCRIMINATION ON THE BASIS OF RACE, NATIONAL ORIGIN, SEX, AGE, HANDICAP OR MARITAL STATUS IN ANY PROGRAM, SERVICE OR ACTIVITY FOR WHICH THE OREGON DEPARTMENT OF EDUCATION IS RESPONSIBLE. THE DEPARTMENT WILL COMPLY WITH THE REQUIREMENTS OF STATE AND FEDERAL LAW CONCERNING NON-DISCRIMINATION AND WILL STRIVE BY ITS ACTIONS TO ENHANCE THE DIGNITY AND WORTH OF ALL PERSONS.

STATEMENT OF DEVELOPMENT

THIS PROJECT WAS DEVELOPED AND PRODUCED UNDER A SUB-CONTRACT FOR THE OREGON DEPARTMENT OF EDUCATION BY LANE COMMUNITY COLLEGE, APPRENTICESHIP DIVISION, EUGENE, OREGON, 1984.

LANE COMMUNITY COLLEGE IS AN AFFIRMATIVE ACTION/EQUAL OPPORTUNITY INSTITUTION.

APPRENTICESHIP

MILLWRIGHT
RELATED TRAINING MODULES

SAFETY

1.1 General Safety
1.2 Hand Tool Safety
1.3 Power Tool Safety
1.4 Fire Safety
1.5 Hygiene Safety
1.6 Safety and Electricity
1.7 Fire Types and Prevention
1.8 Machine Safeguarding (includes OSHA Handbook)

ELECTRICITY/ELECTRONICS

2.1 Basics of Energy
2.2 Atomic Theory
2.3 Electrical Conduction
2.4 Basics of Direct Current
2.5 Introduction to Circuits
2.6 Reading Scales
2.7 Using a V.O.M.
2.8 OHM'S Law
2.9 Power and Watt's Law
2.10 Kirchoff's Current Law
2.11 Kirchoff's Voltage Law
2.12 Series Resistive Circuits
2.13 Parallel Resistive Circuits
2.14 Series - Parallel Resistive Circuits
2.15 Switches and Relays
2.16 Basics of Alternating Currents
2.17 Magnetism

COMPUTERS

3.1 Digital Language
3.2 Digital Logic
3.3 Computer Overview
3.4 Computer Software

TOOLS

4.1 Boring and Drilling Tools
4.2 Cutting Tools, Files and Abrasives
4.3 Holding and Fastening Tools
4.4 Fastening Devices
4.5 Basic Science - Simple Mechanics
4.6 Fasteners

DRAFTING

5.1 Types of Drawing and Views
5.2 Sketching
5.3 Blueprint Reading/Working Drawings
5.4 Working Drawings for Machines and Welding
5.5 Machine and Welding Symbols
5.6 Blueprint Reading, Drafting: Basic Print Reading
5.7 Blueprint Reading, Drafting: Basic Print Reading
5.8 Blueprint Reading, Drafting: Basic Print Reading
5.9 Blueprint Reading, Drafting: Basic Print Reading
5.10 Blueprint Reading, Drafting: Basic Print Reading
5.11 Blueprint Reading, Drafting: Basic Print Reading
5.12 Blueprint Reading, Drafting: Basic Print Reading
5.13 Blueprint Reading, Drafting: Basic Print Reading
5.14 Drafting, Machine Features
5.15 Drafting, Measurement
5.16 Drafting, Visualization

HUMAN RELATIONS

6.1 Communications Skills
6.2 Feedback
6.3 Individual Strengths
6.4 Interpersonal Conflicts
6.5 Group Problem Solving
6.6 Goal-setting and Decision-making
6.7 Worksite Visits
6.8 Resumes
6.9 Interviews
6.10 Expectation
6.11 Wider Influences and Responsibilities
6.12 Personal Finance

BOILERS

7.1 Boilers - Fire Tube Types
7.2 Boilers - Watertube Types
7.3 Boilers - Construction
7.4 Boilers - Fittings
7.5 Boilers - Operation
7.6 Boilers - Cleaning
7.7 Boilers - Heat Recovery Systems
7.8 Boilers - Instruments and Controls
7.9 Boilers - Piping and Steam Traps

TURBINES

8.1 Steam Turbines - Types
8.2 Steam Turbines - Components
8.3 Steam Turbines - Auxillaries
8.4 Steam Turbines - Operation and Maintenance
8.5 Gas Turbines

PUMPS

9.1 Pumps - Types and Classification
9.2 Pumps - Applications
9.3 Pumps - Construction
9.4 Pumps - Calculating Heat and Flow
9.5 Pumps - Operation
9.6 Pumps - Monitoring and Troubleshooting
9.7 Pumps - Maintenance

COMBUSTION

10.1 Combustion - Process
10.2 Combustion - Types of Fuel
10.3 Combustion - Air and Fuel Gases
10.4 Combustion - Heat Transfer
10.5 Combustion - Wood

GENERATORS

11.1 Generators - Types and Construction
11.2 Generators - Operation

FEEDWATER

12.1 Feedwater - Types and Equipment
12.2 Feedwater - Water Treatments
12.3 Feedwater - Testing

AIR COMPRESSORS

13.1 Air Compressors - Types
13.2 Air Compressors - Operation and Maintenance

STEAM

14.1 Steam - Formation and Evaporation
14.2 Steam - Types
14.3 Steam - Transport
14.4 Steam - Purification

MISCELLANEOUS

15.1 Installation - Foundations
15.2 Installation - Alignment
15.3 Circuit Protection
15.4 Transformers
15.5 Trade Terms

TRADE MATH

16.1 Linear - Measure
16.2 Whole Numbers
16.3 Additional and Subtraction of Common Fraction and Mixed Numbers
16.4 Multiplication and Division of Common Fractions and Whole and Mixed Numbers

16.5 Compound Numbers
16.6 Percent
16.7 Ratio and Proportion
16.8 Perimeters, Areas and Volumes
16.9 Circumference and Wide Area of Circles
16.10 Area of Plane, Figures and Volumes of Solid Figures
16.11 Metrics

HYDRAULICS

17.1 Hydraulics - Lever
17.2 Hydraulics - Transmission of Force
17.3 Hydraulics - Symbols
17.4 Hydraulics - Basic Systems
17.5 Hydraulics - Pumps
17.6 Hydraulics - Pressure Relief Valve
17.7 Hydraulics - Reservoirs
17.8 Hydraulics - Directional Control Valve
17.9 Hydraulics - Cylinders
17.10 Hydraulics - Forces, Area, Pressure
17.11 Hydraulics - Conductors and Connectors
17.12 Hydraulics - Troubleshooting
17.13 Hydraulics - Maintenance

METALLURGY

18.1 Included are NAS packets:
W 3010
W 3011-1
W 3011-2
MS 9001 (1-3-4-8-9-6-7-5-2-9)
MS 9200, 9201

POWER DRIVES

19.1 101. A-B-C-D-E
102. C-D-E
103. B-C-D-E
104. A-C-E-F-G-H-I-J
107. A
108. A

WELDING

20.1 602. A-B-C-D-G-I-L-M
603. A-B-F-G-I
W. 3011-1 refer to Mettallurgy 18.1
WE. MA-18

MILLWRIGHT
SUPPLEMENTARY REFERENCE DIRECTORY

Note: All reference packets are numbered on the upper right-hand corner of the respective cover page.

Supplementary Packet #	Description	Related Training Module	
1.8	Concepts & Techniques of Machine Safeguarding, U.S.D.L., O.S.H.A.	1.8	Machine Safeguarding
12.1	Correspondence Course, Lecture 1, Sec. 2, Steam Generators, Types of Boilers I, S.A.I.T., Calgary, Alberta, Canada	7.1	Boilers, Fire Tube Type
12.2	Correspondence Course, Lecture 2, Sec. 2, Steam Generators, Types of Boikers II, S.A.I.T., Calgary, Alberta, Canada	7.2	Boilers, Water Tube Type
12.3	Correspondence Course, Lecture 2, Sec. 2, Steam Generators, Boiler Construction & Erection, S.A.I.T., Calgary, Alberta, Canada	7.3	Boilers, Construction
12.4	Correspondence Course, Lecture 4, Sec. 2, Steam Generators, Boiler Fittings II, S.A.I.T., Calgary, Alberta, Canada	7.4	Boilers, Fittings
12.4	Correspondence Course, Lecture 4, Sec. 2, Steam Generators, Boiler Fitting I, S.A.I.T., Calgary, Alberta, Canada	7.4	Boilers, Fittings
12.5	Correspondence Course, Lecture 10, Sec. 2, Steam Generation, Boiler Operation, Maintenance, Inspection, S.A.I.T., Calgary, Alberta, Canada	7.5	Boilers, Operation
12.7	Correspondence Course, Lecture 3, Sec. 2, Steam Generation, Boiler Details, S.A.I.T., Calgary, Alberta, Canada	7.7	Boilers Heat Recovery Systems
		PUMPS	
13.1	Correspondence Course, Lecture 9, Sec. 2, Steam Generator, Power Plant Pumps, S.A.I.T., Calgary, Alberta, Canada	9.1	Types & Classifications
13.2		9.2	Applications
13.4		9.4	Calculating Heat & Flow
13.6		9.6	Monitoring & Troubleshooting
13.7		9.7	Maintenance
13.3	Correspondence Course, Lecture 6, Sec. 3, Steam Generators, Pumps, S.A.I.T., Calgary, Alberta, Canada	9.3	Construction
13.5		9.5	Operation

Supplementary Packet #	Description	Related Training Module
14.3 12.8	Correspondence Course, Lecture 6, Sec. 3, Steam Generators, Steam Generator Controls, S.A.I.T., Calgary, Alberta, Canada	14.3 Steam Transport 7.8 Boilers, Instruments & Controls
14.4	Correspondence Course, Lecture 11, Sec. 2, Steam Generators, Piping II, S.A.I.T., Calgary, Alberta, Canada	14.4 Steam Purification
15.1	Correspondence Course, Lecture 1, Sec. 4, Prime Movers, & Auxiliaries, Steam Turbines, S.A.I.T., Calgary, Alberta, Canada	8.1 Steam Turbines, Types
15.2	Correspondence Course, Lecture 4, Sec. 3, Prime Movers, Steam Turbines I, S.A.I.T., Calgary, Alberta, Canada	8.2 Steam Turbines, Components
15.3	Correspondence Course, Lecture 2, Sec. 4, Prime Movers & Auxiliaries, Steam Turbine Auxiliaries, S.A.I.T., Calgary, Alberta, Canada	8.3 Steam Turbines, Auxiliaries
15.4	Correspondence Course, Lecture 6, Sec. 3, Prime Movers, Steam Turbine Operation & Maintenance, S.A.I.T., Calgary, Alberta, Canada	8.4 Steam Turbines, Operation & Maintenance
15.5	Correspondence Course, Lecture 8, Sec. 3, Prime Movers, Gas Turbines, S.A.I.T., Calgary, Alberta, Canada	8.5 Gas Turbines
16.2	Boilers Fired with Wood & Bark Residues, D.D. Junge, F.R.L., O.S.U., 1975	10.2 Combustion Types of Fuel
16.2	Correspondence Course, Lecture 5, Sec. 2, Steam Generators, Fuel Combustion, S.A.I.T., Calgary, Alberta, Canada	10.2 Combustion Types of Fuel
16.3	Correspondence Course, Lecture 5, Sec. 2, Plant Services, Fuel & Combustion, S.A.I.T., Calgary, Alberta, Canada	10.3 Combustion Air & Fuel Gases
17.1	Correspondence Course, Lecture 12, Sec. 3, Steam Generation, Water Treatment, S.A.I.T., Calgary, Alberta, Canada	12.1 Feedwater, Types & Operation
17.2	Correspondence Course, Lecture 12, Sec. 2, Steam Generation, Water Treatment, S.A.I.T., Calgary, Alberta, Canada	12.2 Feedwater, Water Treatments

Supplementary Packet #	Description	Related Training Module
17.3	Correspondence Course, Lecture 7, Sec. 2, Steam Generators, Boiler Feedwater Treatment, S.A.I.T., Calgary, Alberta, Canada	12.3 Feedwater, Testing
18.1	Correspondence Course, Lecture 2, Sec. 5, Electricity, Direct Current Machines, S.A.I.T., Calgary, Alberta, Canada	11.1 Generators, Types & Construction
18.1 18.2	Correspondence Course, Lecture 4, Sec. 5, Electricity, Alternating Current Generators, S.A.I.T., Calgary, Alberta, Canada	11.1 Generators, Types & Construction 18.2 Generators, Operation
19.1	Correspondence Course, Lecture 5, Sec. 4, Prime Movers & Auxiliaries, Air Compressor I, S.A.I.T., Calgary, Alberta, Canada	13.1 Air Compressors, Types
19.1	Correspondence Course, Lecture 6, Sec. 4, Prime Movers & Auxiliaries, Air Compressors II, S.A.I.T., Calgary, Alberta, Canada	13.1 Air Compressors, Types 13.2 Air Compressors, Operation & Maintenance
20.1	Basic Electronics, Power Transformers, EL-BE-51	15.4 Transformers
21.1	Correspondence Course, Lecture 6, Sec. 5, Electricity, Switchgear & Circuit, Protective Equipment, S.A.I.T., Calgary, Alberta, Canada	15.3 Circuit Protection
22.1	Correspondence Course, Lecture 10, Sec. 3, Prime Movers, Power Plant Erection & Installation, S.A.I.T., Calgary, Alberta, Canada	15.1 Installation Foundations

RECOMMENDATIONS FOR USING TRAINING MODULES

The following pages list modules and their corresponding numbers for this particular apprenticeship trade. As related training classroom hours vary for different reasons throughout the state, we recommend that the individual apprenticeship committees divide the total packets to fit their individual class schedules.

There are over 130 modules available. Apprentices can complete the whole set by the end of their indentured apprenticeships. Some apprentices may already have knowledge and skills that are covered in particular modules. In those cases, perhaps credit could be granted for those subjects, allowing apprentcies to advance to the remaining modules.

We suggest the the apprenticeship instructors assign the modules in numerical order to make this learning tool most effective.

SUPPLEMENTARY INFORMATION

ON CASSETTE TAPES

Tape 1: Fire Tube Boilers - Water Tube Boilers and Boiler Manholes and Safety Precautions

Tape 2: Boiler Fittings, Valves, Injectors, Pumps and Steam Traps

Tape 3: Combustion, Boiler Care and Heat Transfer and Feed Water Types

Tape 4: Boiler Safety and Steam Turbines

NOTE: The above cassette tapes are intended as additional reference material for the respective modules, as indicated, and not designated as a required assignment.

Modules 18.1, 19.1, and 20.1 have been omitted because they contain dated materials.

3.1

DIGITAL LANGUAGE

Goal:

The apprentice will be able to describe digital language.

Performance Indicators:

1. Identify numbers in decimal, binary, octal and hexidecimal systems.
2. Convert to decimal numbers.
3. Convert to binary and hexi-decimal numbers.
4. Convert to binary and octal numbers.

BASIC ELECTRONICS

Digital Language
EL-BE-54

Test Draft
September 1981

Acknowledgment

Funds for this project were provided by the Governor's Grant, Comprehensive Employment and Training Act (CETA). The activity is a State Education Agency undertaking. The opinions expressed herein do not necessarily reflect the position or policy of either the Oregon Bureau of Labor and Industries or the Oregon Department of Education, and no official endorsement by the State of Oregon or the U.S. Government should be inferred.

Project Director—John W. Havery, Specialist, Oregon Department of Education
Coordinator and Editor—Barbara Edge
Writers: Douglas Draper, Portland Community College, Portland, Oregon
Vernon Hartshorn, Mt. Hood Community College, Gresham, Oregon
George McElmury, Cleveland High School, Portland, Oregon
Donald Wardwell, Mt. Hood Community College, Gresham, Oregon

Graphics: George Kraus, Salem, Oregon

Statement of Assurance

Federal law prohibits discrimination on the basis of race, color or national origin (Title VI of the Civil Rights Act of 1964); sex (Title IX of the Educational Amendments of 1972 and Title II of the Vocational Education Amendments of 1976); or handicap (Section 504 of the Rehabilitation Act of 1973) in educational programs and activities which receive federal assistance. Oregon laws prohibiting discrimination include ORS 659.150 and 659.030. The State Board of Education, furthermore, has adopted Oregon Administrative Rules regarding equal opportunity and nondiscrimination: OARs 581-21-045 through -049 and OAR 581-22-505.

It is the policy of the State Board of Education and a priority of the Oregon Department of Education to ensure equal opportunity in all educational programs and activities and in employment. The Department provides assistance as needed throughout the state's educational system concerning issues of equal opportunity, and has designated the following as responsible for coordinating the Department's efforts:

Title II—Vocational Education Equal Opportunity Specialist
Title VI—Equal Education and Legal Specialist
Title IX—Associate Superintendent, Educational Program Audit Division, and Equal Education and Legal Specialist
Section 504—Specialist for Speech, Language and Hearing, Special Education Section

Inquiries may be addressed to the Oregon Department of Education, 700 Pringle Parkway SE, Salem 97310 or to the Regional Office for Civil Rights, Region X, 1321 Second Avenue, Seattle 98101.

DIGITAL LANGUAGE

Goal:

The apprentice will be able to describe digital language.

Performance Indicators:

1. Identify numbers in decimal, binary, octal and hexidecimal systems.
2. Convert to decimal numbers.
3. Convert to binary and hexi-decimal numbers.
4. Convert to binary and octal numbers.

Objectives

Given:	The student will:
A mixed group of numbers.	Identify numbers in decimal, binary, octal and hexadecimal.
A group of binary numbers between zero and 16.	Convert to decimal.
A group of octal numbers.	Convert to binary and hexadecimal.
A group of hexadecimal numbers.	Convert to binary and octal.

Directions

Obtain the following:

Paper and pencil

Learning Activities

_____ Read Key Words list.

_____ Read Information Sheets.

_____ Do Self-Tests.

_____ Complete Final Test.

_____ Obtain Final Evaluation.

Key Words

Instruction: That part of a computer program that tells the central processing unit how to manipulate data.

Data: The variable information that is stored, manipulated, and processed by a computer.

Binary number system: The positional notation number system with two as its base.

Decimal number system: The positional notation number system with ten as its base.

Decimal point: A symbol ((.) period) used in the decimal system that separates whole numbers on the left with 1/10 unit fractions on the right.

Binary point: A symbol ((.) period) used in the binary system that separates whole numbers on the left with 1/2 unit fractions on the right.

Radix: Also called the base. The total number of characters in a number system. The number by which a digit must be multiplied in each place of positional notation. Example: In decimal, each column to the left must be multiplied by ten.

Base: See radix.

Power: (or exponent) The number above and to the right of another number, like 5^2, that tells how many times it should be used in multiplying by itself:

$$5^2 = 5 \times 5 = 25.$$

Bit: Binary digIT. A single column of binary used in a computer as a single machine language character. There are usually eight bits to a byte.

Octal number system: The positional notation number system with eight as its base.

Hexadecimal number system: The positional notation number system with sixteen as its base.

OVERVIEW

Computers use the binary number system as their language. When a computer screen displays an elaborate picture or when a printer prints out the answer to a complex scientific problem, all of the processing has been done in binary. You will learn about binary in this package. Octal and hexadecimal are merely variations on the binary system that will help people communicate with computers.

Electronic digital systems employ two-state devices. All information, either instruction or data, is in the form of 0's and 1's. The binary system of counting is essential in organizing this information.

The number system we are most used to is the decimal system. The decimal system is based on the number 10. It has ten characters; 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. Quantities are represented by these characters and the column which they are in.

These columns increase in weight to the left of the decimal point by a power of ten. That is to say, when you exceed the capacity of the "ones" column, you must then make use of the column to its left, which is ten times greater or the "tens" column. When you run out of characters in those two columns at "99," you must spill over into the next column where each character represents "100" or ten to the second power (10^2). This is called "positional notation."

The same is true of the binary system except that you only use two characters: zero and 1. Each column increases in weight to the left of the binary point by a power of two.

Columns	Fours	Twos	Ones
1 0 1 (characters)	1	0	1
	1 x 4	0 x 2	1 x 1

Following is an example of characters from 0-15 in decimal and binary:

Decimal

10^3	10^2	10^1	1s column
			0
			1
			2
			3
			4
			5
			6
			7
			8
			9
		1	0
		1	1
		1	2
		1	3
		1	4
		1	5

Binary

2^3	2^2	2^1	1s
			0
			1
		1	0
		1	1
	1	0	0
	1	0	1
	1	1	0
	1	1	1
1	0	0	0
1	0	0	1
1	0	1	0
1	0	1	1
1	1	0	0
1	1	0	1
1	1	1	0
1	1	1	1

Notice the similarities and differences between the two systems of numbering: Base 10 - decimal and Base 2 - binary.

1. There are 10 characters in Decimal 0-9. There are 2 characters in binary 0 and 1.

2. The base (or radix) does not appear in this set of characters.

3. There is only one character in each column.

4. Each column is greater by the "base power" than the column to its right, and smaller by the "base power" than the column to its left.

Example:

Decimal $6\ 3\ 2_{10}$ The subscript (10) tells the base (if not present, it is generally assumed to be 10).

The 3 represents a value 10 times greater than a character in the column to its right and 10 times less than one in the column to its left.

Binary $1\ 1\ 1\ 0_2$

$8 + 4 + 2 + 0 = 14_{10}$

The 1 in the second column is 2 times greater than the character in the first column (0). Each lateral position to the left increases by a power of 2.

2^5	2^4	2^3	2^2	2^1	2^0	
32	16	8	4	2	1	----first column "ones."
1	0	0	0	0	0	

Powers Any number to the zero power is equal to one: $2^0 = 1$, $10^0 = 1$

Any number to the first power is equal to itself.

$2^1 = 2$, $5^1 = 5$, $10^1 = 10$, $10^0 = 1$

Refer to the Decimal/Binary chart. Notice the first column of binary: the highest you can count is one, then you start over again in that column with zero and have a "one" in the second or "two" column. For three we can add another unit to the "ones" column (a "1" in the twos column plus a "1" in the ones column equal three).

$11_2 = 3_{10}$

These rules apply to any of the binary columns.

$100_2 = 4_{10}$

$101_2 = 5_{10}$

$110_2 = 6_{10}$ and so on

Try counting to ten in binary. Check your answers by referring to the Decimal/ Binary chart.

10	2
0	
1	
2	
3	
4	
5	

10	2
6	
7	
8	
9	
10	

Self-Test No. 1

Give decimal equivalent of these binary numbers.

1. 1011 = _____
2. 101 = _____
3. 10 = _____
4. 100 = _____
5. 1000 = _____
6. 1111 = _____
7. 1010 = _____
8. 1001 = _____
9. 111 = _____
10. 1100 = _____

It should be noted that each output or input in a digital gate, circuit, or system may be likened to a single column of binary. Each column is known as a bit (binary digit).

The number of possible binary states from a given number of outputs or bits is 2 to that power. Say you have 2 outputs; you would have 2^2 or four states.

outputs	1	2
states	0	0
	0	1
4	1	0
	1	1

Don't forget zero!!
It is a viable state.

4 outputs can give you 2^4 or 16 states or conditions. 8 outputs can give you 2^8 or 256 states or conditions. You can see that the number of states increases at a rapid pace once you get into higher numbers of binary output.

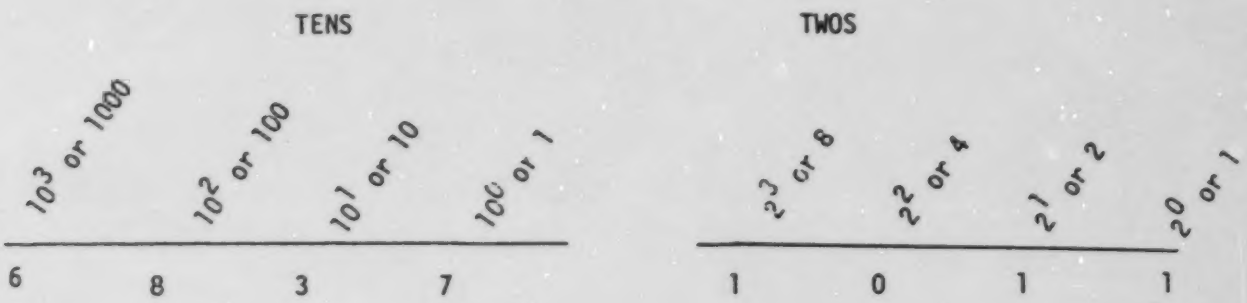
In both the decimal and the binary number system we use positional notation. There are three basic rules that apply to any number system that uses positional notation.

1. The number of digits or characters is equal to the base. (Decimal is base ten 0-9 and binary is base two 0-1.)
2. The largest digit is one less than the base (largest in decimal is 9 and largest in binary is 1).

3. Each digit is multiplied by the base raised to the appropriate power for the digit position. Higher digits increase by the next power of the base for each position to the left: the power of ten in decimal and power of 2 in binary.

For example, in the number "6 8 3 7" we see the "3" is multiplied by the base ten. The "8" is multiplied by the next higher power of the base (10^2 or one hundred). The "6" is multiplied by the next higher power of the base (10^3 and so on).

The same thing happens in base two. Each column to the left represents an increased power of two.



There are two other number systems that are used in digital electronics: octal, base 8 and hexadecimal, base 16.

Computer programmers or translators must work in the "machine language" of binary. It becomes very difficult to memorize the various binary sequences, much as you might memorize your zip code, driver's license, or telephone number. There is a higher degree of error when humans try to program in straight binary. But base 8, (0-7) and base 16, (0-F) compare to the decimal system and are compatible with each other through binary.

Any octal digit (0-7) can be represented by three digits of binary.

OCTAL (Base 8)	BINARY (Base 2)	DECIMAL (Base 10)
0	0	0
1	1	1
2	10	2
3	11	3
4	100	4
5	101	5
6	110	6
7	111	7
10	1000	8
11	1001	9

AND IT COMES OUT EVEN!!

To convert from binary to octal, you start at the ones column and count off by threes toward the left.

1 1 0 1 0 1 1 1 1 1 BINARY

Convert each three binary columns to an octal digit:

001 101 011 111
1 5 3 7 OCTAL

To convert back from octal to binary you just convert each octal digit to three columns of binary (fill in zeros to the left, if there aren't three digits in the binary notation).

$3_8 = 011_2$

Each digit of Hex (0-F) can be represented by four binary digits

	HEXADECIMAL (Base 16)	BINARY (Base 2)
	0	0000
	1	0001
	2	0010
	3	0011
	4	0100
	5	0101
	6	0110
	7	0111
Run out of decimal characters, use letters ⟶	8	1000
	9	1001
	A	1010
	B	1011
	C	1100
	D	1101
To remember: 3-Fs FINAL-F-FIFTEEN ⟶	E	1110
	F	1111

Once within any of these three systems, conversions are extremely easy once you memorize the chart above. Any number in hex can be converted to binary then to the octal. The reverse is also true.

CONSIDER:	5	7	3	6_8	Octal
	101	111	011	110	Binary (grouped in threes)
	1011	1101	1110		Binary (grouped in fours)
	11	13	14		Decimal equivalents of hexadecimal
	B	D	E_{16}		Hexadecimal

CONSIDER:

Convert each digit to binary	5	7	3	6	Octal
	101	111	011	110	Binary (grouped in threes)
Regroup into groups of four	1011	1101	1100		Same binary numbers (grouped in fours)
Convert from binary to decimal	11	13	14		Decimal equivalents of hexadecimal
Convert to hex	B	D	E		Hexadecimal

ADDITIONAL EXAMPLES

Binary to octal: $11101110111_2 = \underline{\quad ? \quad}_8$

11 101 110 111 $= \underline{3547}_8$

3 5 4 7

Octal to binary: $6372_8 = \underline{\quad ? \quad}_2$

6 3 7 2

110 011 111 010 $= \underline{110011111010}_2$

Binary to hex: $111001111001110_2 = \underline{\quad ? \quad}_{16}$

	11	1001	1110	0110	
Decimal	3	9	14	6	
	3	9	E	6	$= \underline{39E6}_{16}$

Hex to binary $6A7B_{16} = \underline{\quad ? \quad}_2$

	6	A	7	B	
Decimal	6	10	7	11	
	0110	1010	0111	1011	= 110101001111011

Self-Test No. 2

Convert:

from binary to octal -
Remember that you are working in binary grouped in threes.

1. 1011100 _____
2. 10101010 _____
3. 11111111 _____
4. 1111111 _____
5. 10000 _____
6. 110101 _____
7. 110001 _____
8. 1010110 _____
9. 1101101 _____
10. 1011101 _____

from octal to binary -

11. 537 _____
12. 623 _____
13. 425 _____
14. 142 _____
15. 100 _____
16. 72 _____
17. 10 _____
18. 111 _____
19. 666 _____
20. 777 _____

Self-Test No. 3

Try converting some hexadecimal and binary:

From binary to hex -

Remember that you are working in binary grouped in fours.

1. 101100 _____
2. 10101010 _____
3. 11111111 _____
4. 1111111 _____
5. 10000 _____
6. 110101 _____
7. 110001 _____
8. 1010110 _____
9. 1101101 _____
10. 1011101 _____

From hex to binary -

11. 537 _____
12. 623 _____
13. 425 _____
14. F39 _____
15. D15 _____
16. BAD _____
17. 709 _____
18. 619 _____
19. 999 _____
20. FFF _____

To convert from octal to hex or back, you first should convert to binary, then, starting from the right, group your binary columns in threes for octal and fours for hex. Then convert these binary groups to octal or hex digits and you will be finished.

EXAMPLE I:

Convert 25_8 to hex

		2	5
Step 1.	Convert to binary	010	101
Step 2.	Group in 4's	01	0101
Step 3.	Convert to hex	1	5

Therefore $25_8 = 15_{16}$

EXAMPLE II:

Convert 25_{16} to octal

		2	5
Step 1.	Convert to binary	0010	0101
Step 2.	Group in 3s	00 100	101
Step 3.	Convert to octal	4	5

Therefore $25_{16} = 45_8$

Self-Test No. 4

Convert the following:

TO HEX

1. 37_8 = _____
2. 15_8 = _____
3. 777_8 = _____
4. 135_8 = _____
5. 472_8 = _____

TO OCTAL

6. 7B = _____
7. 490 = _____
8. 302 = _____
9. AAF = _____
10. 43 = _____

Self-Test No. 5

MATCH TERMS TO BLANKS

1. Digital electronic devices operate in the _____ number system.
2. Two number systems that are "compatible" with binary are _____ and _____.
3. The octal number system has _____ characters or symbols.
4. The hexadecimal number system has _____ characters or symbols.
5. The highest you can count in any one column of hexadecimal is _____.
6. The highest you can count in a single column of binary is _____.
7. The highest you can count in a single column of octal is _____.
8. Any octal digit can be represented by _____ columns of binary.
9. Any hexadecimal numeral can be represented by _____ columns of binary.

a. seven
b. four
c. one
d. three
e. eight
f. hexadecimal
g. sixteen
h. binary
i. octal
j. fifteen or F

Self-Test No. 6

CONVERT:

1. 1010110_2 to _____ 8.
2. $A539_{16}$ to _____ 8.
3. 4663_8 to _____ 16.
4. $59D_{16}$ to _____ 8.
5. 1101101110101_2 to _____ 16.
6. 43_8 to _____ 2.
7. 43_{16} to _____ 2.
8. 101_{16} to _____ 8.
9. 101_8 to _____ 16.
10. 101_2 to _____ 16.

Final Test

CONVERT:

1. AAB_{16} to _____8.
2. 437_{16} to _____8.
3. 1011101011_2 to _____8.
4. 427_8 to _____16.
5. $59F_{16}$ to _____8.
6. 377_8 to _____16.
7. 97_{16} to _____8.
8. 14_8 to _____16.
9. 3333_{16} to _____8.
10. 345_8 to _____16.

Final Evaluation

NAME _____

DATE _____

	OK	RE-DO
90% Accuracy on Final Test.	_____	_____

If all checks indicate OK, go on to next package.

Answers

Self-Test 1

1. 11
2. 5
3. 2
4. 4
5. 8
6. 15
7. 10
8. 9
9. 7
10. 12

Self-Test 2

1. 134
2. 252
3. 377
4. 177
5. 20
6. 65
7. 61
8. 126
9. 155
10. 135
11. 101011111
12. 110010011
13. 100010101
14. 1100010
15. 1000000
16. 111010
17. 1000
18. 1001001
19. 110110110
20. 111111111

Self-Test 3

1. 2C
2. AA
3. FF
4. 7F
5. 10
6. 35
7. 31
8. 56
9. 6D
10. 5D

Self-Test 3 (Continued)

10. 10100110111
12. 11000100011
13. 10000100101
14. 111100111001
15. 110100010101
16. 101110101101
17. 11100001001
18. 11000011001
19. 100110011001
20. 111111111111

Self-Test 4

1. 1F
2. D
3. 1FF
4. 5D
5. 13A
6. 173
7. 2220
8. 1402
9. 5257
10. 103

Self-Test 5

1. Binary (h)
2. Octal (i), Hexadecimal (f)
3. 8 (e)
4. 16 (g)
5 F or 15 (j)
6. 1 (c)
7. 7 (a)
8. 3 (d)
9. 4 (b)

Self-Test 5

1. 126
2. 122471
3 983
4. 2635
5. 36ED
6. 100011
7. 1000011
8. 401
9. 41
10. 5

INSTRUCTIONAL LEARNING SYSTEMS

3.2

DIGITAL LOGIC

Goal:

The apprentice will be able to describe digital logic and gating systems.

Performance Indicators:

1. Describe analog.
2. Describe digital.
3. Describe digital logic families.
4. Describe logic gates.

BASIC ELECTRONICS

Digital Logic
EL-BE-55

Test Draft
September 1981

Acknowledgment

Funds for this project were provided by the Governor's Grant, Comprehensive Employment and Training Act (CETA). The activity is a State Education Agency undertaking. The opinions expressed herein do not necessarily reflect the position or policy of either the Oregon Bureau of Labor and Industries or the Oregon Department of Education, and no official endorsement by the State of Oregon or the U.S. Government should be inferred.

Project Director—John W. Havery, Specialist, Oregon Department of Education
Coordinator and Editor—Barbara Edge
Writers: Douglas Draper, Portland Community College, Portland, Oregon
Vernon Hartshorn, Mt. Hood Community College, Gresham, Oregon
George McElmury, Cleveland High School, Portland, Oregon
Donald Wardwell, Mt. Hood Community College, Gresham, Oregon

Graphics: George Kraus, Salem, Oregon

Statement of Assurance

Federal law prohibits discrimination on the basis of race, color or national origin (Title VI of the Civil Rights Act of 1964); sex (Title IX of the Educational Amendments of 1972 and Title II of the Vocational Education Amendments of 1976); or handicap (Section 504 of the Rehabilitation Act of 1973) in educational programs and activities which receive federal assistance. Oregon laws prohibiting discrimination include ORS 659.150 and 659.030. The State Board of Education, furthermore, has adopted Oregon Administrative Rules regarding equal opportunity and nondiscrimination: OARs 581-21-045 through -049 and OAR 581-22-505.

It is the policy of the State Board of Education and a priority of the Oregon Department of Education to ensure equal opportunity in all educational programs and activities and in employment. The Department provides assistance as needed throughout the state's educational system concerning issues of equal opportunity, and has designated the following as responsible for coordinating the Department's efforts:

Title II—Vocational Education Equal Opportunity Specialist
Title VI—Equal Education and Legal Specialist
Title IX—Associate Superintendent, Educational Program Audit Division, and Equal Education and Legal Specialist
Section 504—Specialist for Speech, Language and Hearing, Special Education Section

Inquiries may be addressed to the Oregon Department of Education, 700 Pringle Parkway SE, Salem 97310 or to the Regional Office for Civil Rights, Region X, 1321 Second Avenue, Seattle 98101.

Objectives

Given:	The student will:
A set of final test questions.	Answer with an accuracy of 80%.
Equipment to perform a task of setting up digital and binary outputs of a binary counter.	Construct circuit properly to show digital and binary readouts.

Directions

Obtain the following:

One 74193 binary counter IC
One 7404 hex inverter IC
One 9368 decoder decimal driver IC
One FND 500 seven-segment LED display
Four light-emitting diodes (LEDs)
One 1 k 1/4 W resistor
One 5 volt 1/2 amp regulated supply
One push-button switch (double-pole, momentary-contact)

Learning Activities

_____ Study Key Words list.

_____ Read and study Information Sheets.

_____ Do Self-Tests.

_____ Do Final Test.

_____ Do Task.

_____ Obtain Final Evaluation.

Key Words

Analog information: Information that is continuous in value and not limited to a fixed number of possible values.

Digital information: Information that is discontinuous in value and has a set number of possible values.

Binary: Having only two values or levels.

Logic family: A certain type of electronic circuitry that performs various digital logic operations. Different families perform the same operations using different circuitry.

Truth table: A table of binary values for the inputs and outputs of logic circuits describing the necessary input conditiions to determine output conditions.

Flip-flop: A circuit having two outputs with opposite binary values. They can be used to store binary values for later use.

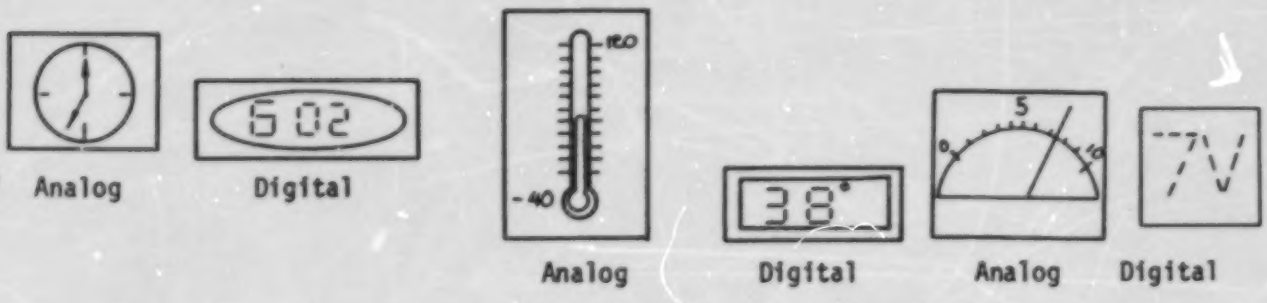
Gate: One of several types of digital logic circuits used to perform various digital logic operations such as AND, OR, NAND, NOR or NOT gates. (See Information Sheets for descriptions of specific gates.)

Information Sheet

Digital logic refers to the numerical operations performed by digital electronic circuits. The electronic circuits you have studied so far have been analog circuits. Digital circuits will be explained later on, but first a comparison between digital and analog methods of representing information will be given. This comparison should help to introduce the subject of digital electronics.

Analog information is continuous. The number of possible values is unlimited. Digital information is not continuous. The number of values is limited or fixed depending upon the complexity of the digital information. This is similar to the difference between going up steps or a ramp. The steps have a fixed number of intermediate levels between two levels whereas the ramp has a continuous number of levels. You may stop on the ramp in a place that would be in between two steps on the series of steps.

Examples of devices that display information in analog form are an ordinary clock or watch, a mercury thermometer, or a meter (VOM) scale.



Analog Digital Analog Digital Analog Digital

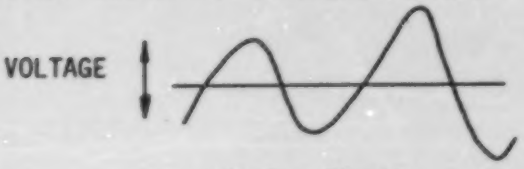
CLOCK THERMOMETER VOLTMETER

There is no limit to the number of positions at which the hands of the clock, the position of the mercury in the thermometer, or the pointer on the VOM scale can rest. The time information is represented continuously from 0 to 60 minutes for the minute hand. The temperature information is continuous from -40 degrees to +120 degrees Fahrenheit for the thermometer, and the voltage information is continuous from 0 to 10 volts for the voltmeter. In theory, any possible values between these limits could be read from these analog devices remembering that the values read could have fractional or decimal parts (i.e., 10½ minutes or 5.75 volts, etc.).

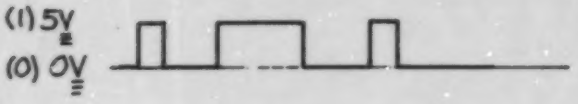
In contrast to this, each of the above instruments has a digital counterpart. The digital instruments have a fixed number of digits in their readouts. For instance, there is a fixed number of minutes that can be read from a digital clock (exactly 60), and also a fixed number of degrees, 160 in this example, are read from the digital thermometer. Only ten values of voltage can be read from the digital voltmeter in the example given.

Many times digital instruments will also give decimal parts such as 5.3 volts instead of just 5 volts. This will increase the number of possible values, but the number is still limited. On the other hand, with analog instruments the number of values that can be read is unlimited, at least in theory. In practice, however, I'm sure you will agree that even the analog instruments are limited by reading accuracy or the ability to determine the difference between two very close positions of the indicator on the scale. The reading accuracy, therefore, is the only thing that limits the number of possible values for analog information. In terms of electrical signals, an analog signal such as a voltage is one that is continuous in voltage. It may have any possible voltage value within the range of values over which it exists. A digital signal has a set or limited number of values or levels within its range.

The most common digital signal is a binary signal which has only two possible values. These two values are usually called a 0 (zero) and a 1 (one). In practice the values might be 0 volts for the zero and 5 volts for the one or any other set of two different values.

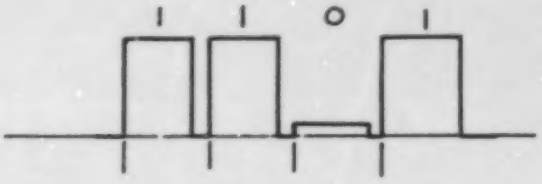


Analog Signal



Binary Digital Signal

How can information having many possible values be represented by a binary electrical signal if the binary signal has only two values? The answer is by using a sequence of several binary values (0s and 1s) to represent a single larger value. You learned how to convert decimal numbers to their binary equivalent values in the last package. For instance, the sequence of binary values 1101 would represent the decimal number 13. In general the larger the number of values of a quantity to be represented by a binary sequence, the longer the sequence must be.



1st Pulse Represents 8
2nd Pulse Represents 4
3rd Pulse Represents 2
4th Pulse Represents 1

Binary Signal (graphically shown as pulses) Representing the Number 13

There have been several levels of development in the history of digital electronics. Early computers used relays with open contacts, then vacuum tubes, then discrete transistors. Most recently came integrated circuits (ICs).

Digital electronic circuits perform basically the same functions that are performed by a series of mechancial switches. When a switch is closed, the binary value of 1 is indicated and when it is open the value of 0 is indicated.

Rather than actually using mechanical switches, various types of electronic circuits perform the equivalent switching functions. The digital circuits that do this are classified into different categories called logic families. The logic families differ in that they use different types of circuits to perform the same functions. The following list shows some of the commonly used digital logic families. The functions that these logic families all perform can be categorized into the following major functions:

AND gates	NAND gates	NOT gates (INVERTERs)
OR gates	NOR gates	FLIP-FLOPs

Some other logic families include the following:

RTL (Resistro-transistor-logic)
DTL (Diode-transistor-logic)
TTL (Transistor-transistor-logic)
PMOS & NMOS (Positive and negative MOS)*
CMOS (Complimentary MOS)*

*Metal oxide semiconductor

This is only a partial listing and each has its own characteristic size, power consumption and operating speed. Each group is called a family and is not usually interchangeable with the others because of voltage requirements, speed, polarity and pin layouts.

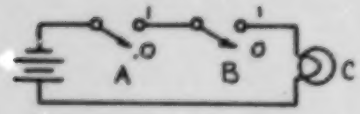
In the following explanations of the functions that these digital circuits perform, a mechanical switch equivalent is also given to help demonstrate the function of the circuit. Only the symbol for the function performed will be given since the circuitry will vary depending on the logic family that is used.

A "1" represents one of the binary values (usually the larger voltage) and also is represented by a closed switch in the switch example. A "0" represents the other binary value (usually the smaller voltage) and an open switch. The inputs are shown on the left side of the symbol and the output on the right. The tables at the right, called truth tables, indicate all possible operating conditions for the inputs and outputs. On any given row in the tables, for the input conditions indicated, the output condition will be as shown.

The AND Gate

Symbol

Switch Example



Truth Table

A	B	C
0	0	0
0	1	0
1	0	0
1	1	1

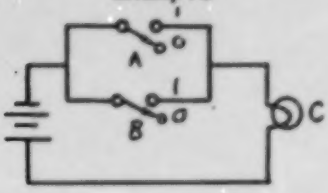
In the AND gate both the inputs must be high to get a high output. A AND B must be 1 to get a 1 at C.

AND gates may have more than two inputs, but all of the inputs must be high for the output to be high. Look at the lamp in the example of our AND gate. Consider the lamp asking if all the switches are closed. It will not respond by turning on until all the switches are closed.

The OR Gate

Symbol

Switch Example



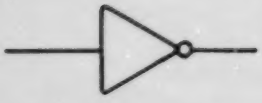
TRUTH TABLE

A	B	C
0	0	0
0	1	1
1	0	1
1	1	1

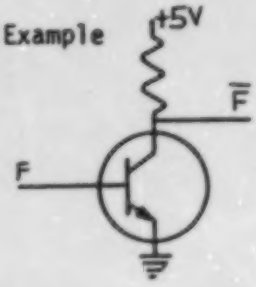
The OR gate will have a high at the output if either OR both inputs are high. OR gates may also have more than two inputs.

The NOT Gate (inverter)

Symbol



Example



TRUTH TABLE

F	F̄
0	1
1	0

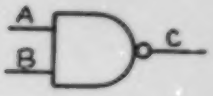
The inverter or NOT gate merely changes the input to its opposite state. So if we get 1 in, we get a $\bar{1}$ or 0 out (the little bar over the top designates the opposite: $\bar{F}$ would be spoken as "not F").

Take a look at the example of the inverter. F is low which turns off the transistor switch. Since this is equal to an "open" to ground, our F will remain at the +5 volt source level. When F goes high, it will forward bias the emitter and turn the transistor on. This will tie $\overline{F}$ to ground or low. So when F is high, $\overline{F}$ is low and when F is low, $\overline{F}$ is high.

The laid-over triangle is the schematic symbol for an amplifier or buffer. The little circle is the actual symbol for inverter.

These three gates are the basis for all logic circuits. Everything else is generally constructed from these three gates. Sounds too simple, doesn't it? But think. These gates are the equivalents of simple on/off switches. Let's look at some "combination gates" and their truth tables.

NAND gate (Negative AND)



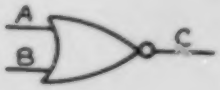
A	B	C
0	0	1
1	0	1
0	1	1
1	1	0

COMPARE:

AND

A	B	C
0	0	0
0	1	0
1	0	0
1	1	1

NOR gate (Negative OR)



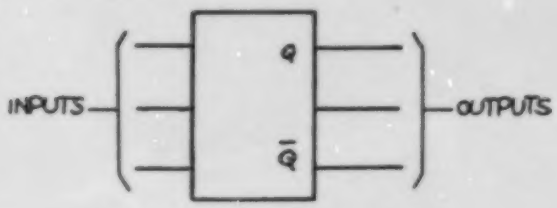
A	B	C
0	0	1
0	1	0
1	0	0
1	1	0

OR

A	B	C
0	0	0
0	1	1
1	0	1
1	1	1

The outputs of each are the opposite of AND and OR gates. This is indicated by the little circle on the right of the standard AND and OR symbols. These gates can be purchased in an "individual-package" form in I.C. chips that have 1 or more gates in them. Some LSI (large-scale integrated) circuits have hundreds of gates. These I.C.s can have from 4 to 40 pins.

FLIP-FLOPs



Two output states

State 1 $Q = 1$, $\overline{Q} = 0$

State 2 $Q = 0$, $\overline{Q} = 1$

A flip-flop stores a binary value until an input changes its value. The flip-flop has two outputs and can have one or more inputs. Each output is either a 1 value or a 0 value and each is the opposite value of the other. In other words, if one of the outputs is a 1, the other will be a 0 and vice-versa. The input signal or signals have the capability of changing the condition of the outputs. Notice that there are just two conditions or states for the outputs. Flip-flops are used for many different operations in digital systems.

Self-Test

Match numbered terms to blanks in questions 1 through 5.

1. A thermometer or an electric clock can have either a _____ or _____ readout.

2. Types of circuits that are used in digital circuits are compatable within their _____.

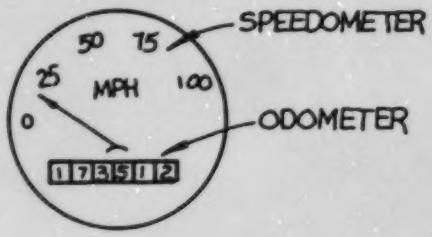
3. Three basic gates are the _____, _____ and _____.

4. Digital electronic circuits perform basically the same functions that can be performed by mechanical _____.

5. A digital circuit having two binary outputs of opposite value is a _____.

a. AND
b. families
c. NOT
d. analog
e. switches
f. OR
g. digital
h. flip-flop

6. Your automobile has both a speedometer and an odometer. The speedometer lets you know how fast you are going, the odometer how far you have gone. One of these is a digital instrument and the other is analog. Which is which? _____



Final Test

1. Truth tables show all possible input and output conditions for _____.
2. A _____ gate is a combination of an AND and a NOT gate.
3. Different classes of circuitry used to perform the same types of digital logic funtions are called logic _____.
4. An automobile speedometer output is _____.
5. The odometer output is _____.
6. Digital circuits perform functions that can also be performed by _____.
7. An inverter is the same as a _____ gate.
8. If all inputs of a gate must be binary 1 to get an output of binary 1, the gate is called a(n) _____ gate.

a. OR
b. AND
c. logic gates
d. NAND
e. NOR
f. families
g. NOT
h. mechanical switches
i. digital
j. analog

Task

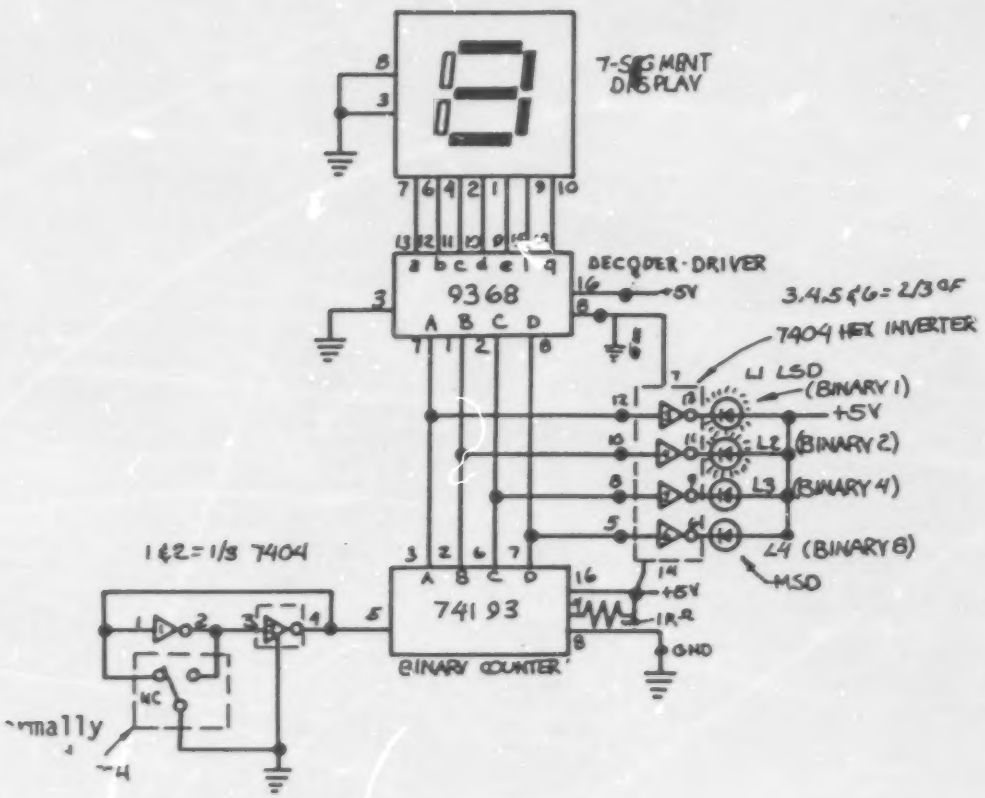
EQUIPMENT

One 74193 binary counter IC
One 7404 hex inverter IC
One 9368 decoder decimal driver IC
One FND 500 seven-segment LED display
Four light-emitting diodes

One 1 k 1/4 W resistor
One 5 volt 1/2 amp regulated supply
One push-button switch (double-pole, momentary-contact).

PROCEDURE:

Hook up the circuit as shown. Be sure you don't bend pins on ICs. Watch polarity on LEDs (keyed side is cathode). Pins on the devices are laid out as shown below.



This circuit consists of a 74193 binary counter, a 9368 binary-to-seven-segment decoder-driver, and a seven-segment LED display. The four binary outputs of the 74193 counter drive the LED indicators L 1 through L 4 and the decoder driver. The output of the decoder-driver is used to drive the seven-segment display. The 7404 hex inverter is used to drive the LED binary indicators, as the 74193 IC will not have power capabilities to drive the LEDs. Two of the inverters are also used to insure proper switching performance. The 74193 will count in binary from zero to fifteen. This will be displayed by the four LEDs. The 9368 will convert the binary to the output needed for the seven-segment display. Transistors in the 9368 will provide required power to drive the seven-segment output.

You should be able to see the numbers change on the seven-segment display and, at the same time, the equivalent binary number displayed on the LEDs.

For instance, when the seven-segment display shows the number 9, the top LED (LSD) and the bottom LED (MSD) should be lit but the other two LEDs unlit representing the binary number 1001. LSD refers to least significant digit (representing a 0 or a 1) and MSD refers to most significant digit (representing a 0 or an 8).

Answers

1. g and d
2. b
3. a, c and f
4. e
5. h
6. Speedometer is analog; odometer is digital.

3.3

COMPUTER OVERVIEW

Goal:

The apprentice will be able to use common computer terminology.

Performance Indicators:

1. Use common terms.
2. Use common acronyms.

BASIC ELECTRONICS

Computer Overview
EL-BE-56

Test Draft
September 1981

Acknowledgment

Funds for this project were provided by the Governor's Grant, Comprehensive Employment and Training Act (CETA). The activity is a State Education Agency undertaking. The opinions expressed herein do not necessarily reflect the position or policy of either the Oregon Bureau of Labor and Industries or the Oregon Department of Education, and no official endorsement by the State of Oregon or the U.S. Government should be inferred.

Project Director—John W. Havery, Specialist, Oregon Department of Education
Coordinator and Editor—Barbara Edge
Writers: Douglas Draper, Portland Community College, Portland, Oregon
Vernon Hartshorn, Mt. Hood Community College, Gresham, Oregon
George McElmury, Cleveland High School, Portland, Oregon
Donald Wardwell, Mt. Hood Community College, Gresham, Oregon

Statement of Assurance

Federal law prohibits discrimination on the basis of race, color or national origin (Title VI of the Civil Rights Act of 1964); sex (Title IX of the Educational Amendments of 1972 and Title II of the Vocational Education Amendments of 1976); or handicap (Section 504 of the Rehabilitation Act of 1973) in educational programs and activities which receive federal assistance. Oregon laws prohibiting discrimination include ORS 659.150 and 659.030. The State Board of Education, furthermore, has adopted Oregon Administrative Rules regarding equal opportunity and nondiscrimination: OARs 581-21-045 through -049 and OAR 581-22-505.

It is the policy of the State Board of Education and a priority of the Oregon Department of Education to ensure equal opportunity in all educational programs and activities and in employment. The Department provides assistance as needed throughout the state's educational system concerning issues of equal opportunity, and has designated the following as responsible for coordinating the Department's efforts:

Title II—Vocational Education Equal Opportunity Specialist
Title VI—Equal Education and Legal Specialist
Title IX—Associate Superintendent, Educational Program Audit Division, and Equal Education and Legal Specialist
Section 504—Specialist for Speech, Language and Hearing, Special Education Section

Inquiries may be addressed to the Oregon Department of Education, 700 Pringle Parkway SE, Salem 97310 or to the Regional Office for Civil Rights, Region X, 1321 Second Avenue, Seattle 98101.

Objectives

Given:	The student will:
A group of computer acronyms.	Write out the terms the acronyms represent.
A set of true/false statements concerning computers.	Correctly identify as true or false within an accuracy of 90%.

Directions

Obtain the following:

Paper and pencil

Learning Activities

_____ Study Key Words List.

_____ Read and study Information Sheets.

_____ Do Self-Test.

_____ Do Final Test.

_____ Obtain Final Evaluation.

Key Words

Buzz Words: The terms used as jargon in the computer field.

Central Processing Unit (CPU): The main processing part of the computer.

Mini-Computer: A smaller, stand-alone computer that requires no special environment.

Micro-Computer: A computer designed around a microprocessor chip.

Main Frame: A regular computer installation which generally requires a special air-conditioned environment.

LSI: Large-Scale Integrated circuit.

Hardware: Physical components and supplies used in computing.

Software: Instructional or program sequences and organization used in computer operations.

Acronym: A word formed by the first letters in the words of a phrase. ROM = Read-Only Memory.

RAM: Random-Access Memory. A memory section of a computer that can store information, either data or instruction, at the first available location, and if it runs out of space at that location, will proceed to the next available memory address or location.

Scratch Pad: The computer's temporary memory that is used as you might use a scratch pad to jot down notes to which you wish to refer.

ALU: Arithmetic Logic Unit. The portion of the ROM that performs mathematical computations.

BYTE: A memory word that consists of eight binary digits.

BIT: BInary DigiT. The basic unit used in computing.

LPS: Lines Per Second. Used to determine printing speed.

CPS: Characters Per Second. Used to determine printing speed.

CRT: Cathode-Ray Tube. A TV screen.

Machine Language: The binary switching logic the computer deals with. The first level of computer language.

Assembly Language: The second level of computer language that translates the higher symbolic compiler languages to the machine language.

Compiler Language: The third level of language that is more like the language we speak. BASIC and COBOL are compiler languages.

Fortran: A computer language used in science.

Cobol: A computer language used in business.

Basic: A computer language designed for engineering use.

Subroutine: A section of a program that can stand alone and may be reused.

Data: That information the computer processes.

ROM: Read-Only Memory: The controlling section of the computer's memory.

Information Sheet

The information contained in this learning package will help you understand some of the history and "state-of-the-art" generations of computers. Study the package carefully and learn the terms. When you hear them later, they will make sense to you. Many of us are separated from the computer world by the terms and "buzz words" of the field.

The computer of today has been developing since the early 1940s. The original computers were primarily for use in performing calculations of numbers. Today's equipment is used for processing any kind of information. This period is becoming known as the "Information Age," and computers are the reason. Memory storage and access speeds are increasing almost daily, and the costs of computers are coming down rapidly. This progress is touching all of our lives and will continue to do so. There will be many employment opportunities in the design, use, maintenance and repair of this equipment. It is likely that there will be very few occupations that won't need some background in this area.

The early computers of the 40s and 50s were very large and used vacuum tubes as the electronic switches. These machines used a great deal of power and gave off a great deal of heat. The central processing unit (CPU), or main frame and memory storage equipment, was in a special air-conditioned room to keep the equipment clean and cool. Even today, many computer hardware installations require these kinds of special environments. In 1948 the transistor was developed. The transistor made computers much smaller and more reliable. Though temperature does affect all electronic equipment, the more modern information processing equipment consumes less power, so doesn't generate as much heat.

Many of today's computers are smaller in size, and new technology has grown from several directions, evolving minicomputers and microcomputers. Developments within these "size-oriented" divisions have occurred so rapidly that it's difficult to define them. Generally, though, the minicomputer is one that is smaller in size than the earlier main-frame computers and doesn't need a special environment. The microcomputers developed around the microprocessor, which is a single large-scale integrated chip (LSI) that can actually process commands and be expanded by adding memory.

Computing or information processing is composed of two interdependent divisions: the hardware and the software. Hardware is the sum total of all the electronic components, memories, keyboards, CRTs, printers, tapes, discs and cards. All of the physical equipment is hardware. Software is the program or the instructions that direct the computer in its processing activities.

The computer's program language (machine language) is the binary number system. Humans, however, do not deal with binary so well. Higher level program languages have been developed for humans to communicate with computers, beginning with

octal and hexadecimal. Assembly languages, which are symbols and codes, are used to communicate with the machines. These are still only numbers and symbols. To do all of our communicating with only numbers and code symbols is very awkward. Therefore, more complex, higher level languages were developed. The languages initially were developed by computer companies for their own machines, and then languages were developed for particular applications. FORTRAN (FORmula TRANslation) was developed for the scientific community. COBOL (COmmon Business Oriented Language) is used to express problems in data processing in English narrative form. BASIC is a simplified program language intended for use in engineering applications. There have been many other languages designed for certain hardware and user applications, but these three have been the most widely applied.

The development of software has been slower than the advancements in hardware technology, but predictions promise an explosion of software in the very near future. With the availability of personal computers and the increasing capabilities of hardware and standardization of phrases and subroutines, we should witness a very exciting era of progress.

The hardware portion of a computer consists of several major components. All computers have an input, an output, a central processing unit (CPU), and to a greater or lesser extent, a memory.

Inputs can be as simple as a voltage sensor, light sensor, or switch. The keys on a computer terminal keyboard are switches.

The output may be a solenoid-driven printer or a cathode-ray tube (CRT) or, perhaps, a single lamp or LED. It may switch the power to a servo motor (control motor) of a computerized manufacturing machine or trigger the data through the electromagnetic recording head of a computer tape or disc pack. Some may serially dump pulsating square wave signals to generate audio signal frequency to simulate a human voice.

The Central Processing Unit, or CPU, is where the input data is recognized and stored as instructed by the program or the controlling section of the computer--the Read-Only Memory (ROM). The ROM will process the data and will use the Random-Access Memory (RAM) for temporary storage for "scratch pad" use and proper sequencing. The Arithmetic Logic Unit (ALU), which is part of ROM, will process the mathematics.

Once the information has been processed properly, it may be stored on a type of storage media such as a magnetic tape or disc.

Computers of the seventies would commonly have 64 k of memory. 64 k stands for sixty-four kilobyte or sixty-four thousand bytes of internal RAM. A byte is an 8-bit word. Remember a bit is a BInary digiT or a serial pulse on a two-state data track. It is not uncommon today for computers to have 96 megabytes or 96 million bytes of Random-Access Memory and be smaller than their ten-year-old

counterparts. The size and density of these systems are increasing their power. The access and output speed is another ingredient in their power. Laser printers print at speeds of 900 Lines Per Second (LPS) and are still too slow. The maximum printing speed of an IBM Selectric Typewriter is fifteen and one-half Characters Per Second (CPS). Daisey wheel printers are driven at around seventeen to fifty CPS. Dot matrix printers and belt or chain printers may print at three to 40 LPS.

Computers are now an integral part of our lives and will continue to expand further into the 80s and the 90s.

In this time of rapid change in the economic and technical worlds, many careers will change dramatically or even die out. This is not likely to happen to you if you choose a career in the computer field.

Self-Test

Acronyms are words formed by the first letters of a group of words that is frequently used. Below you will find a list of acronyms. Write out the phrases tht these acronyms stand for.

1. LSI _____
2. ALU _____
3. CRT _____
4. BIT _____
5. LPS _____
6. RAM _____
7. ROM _____

True/False

8. Computers of today have many vacuum tubes. _____
9. Software technology is way ahead of hardware technology. _____
10. 96 megabytes is a memory possible today. _____
11. The input to a computer may be a switch or group of switches. _____
12. ROM stores random memory. _____
13. Magnetic tape is a type of storage media. _____
14. COBOL is a compiler language. _____
15. The transistor was invented in 1948. _____
16. The binary number system is the easiest computer language for humans to use. _____
17. A byte is 24 bits. _____

Final Test

Write out proper phrase for the acronym.

1. ROM _____
2. RAM _____
3. CRT _____
4. ALU _____
5. LPS _____
6. LSI _____
7. BIT _____

True/False

_____ 8. Storage media may be a magnetic disc.

_____ 9. A byte is 64 bits.

_____ 10. 900 LPS is fast printing.

_____ 11. FORTRAN is a common output device.

_____ 12. The transistor was developed in 1938.

_____ 13. It is an easy task for humans to program in straight binary.

_____ 14. Memory in computers can be very large or quite small.

_____ 15. A career in computer service is extremely limited.

Final Evaluation

	OK	RE-DO
90% accuracy on Final Test	_____	_____

Answers

Self-Test Answers

1. Large-Scale Integrated
2. Arithmetic Logic Unit
3. Cathode-Ray Tube
4. Binary Digit
5. Lines Per Second
6. Random-Access Memory
7. Read-Only Memory
8. F
9. F
10. T
11. T
12. F
13. T
14. T
15. T
16. F
17. F

3.4

COMPUTER SOFTWARE

Goal:

The apprentice will be able to describe proper care and handling of software.

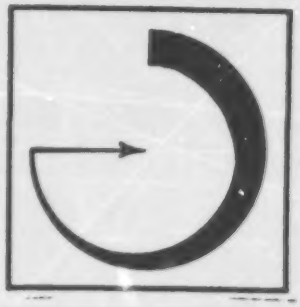
Performance Indicators:

1. Describe types of software.
2. Describe handling of software.
3. Describe identification of software.

Study Guide

* Read the goal and performance indicators to find what is to be learned from package.
* Read the vocabulary list to find new words that will be used in package.
* Read the introduction and information sheets.
* Complete the job sheet.
* Complete self-assessment.
* Complete post-assessment.

Vocabulary



* Cassette
* Central processing unit (CPI)
* Diskette
* Floppy disk
* Hard disk
* Magnetic tape
* Mainframe
* Microcomputer

Introduction

Modern steam plants use the computer to control many of the plant functions that were previously operated manually. The process steps are programmed into a computer so that each command is given in the proper sequence.

The computerized controls may be part of a central processing unit (CPU) which uses a computer mainframe to operate the program. A mainframe is a computer that requires a controlled environment and has vast memory storage capacity. In other cases it may be operated by a microcomputer that uses diskettes or cassettes as software. A microcomputer is a computer designed around a microprocessor chip.

This package is merely an introduction to software. The operator must complete further study of software packages that are specific to the type of computer being used with the software.

Information

Types of Software

Microcomputers use two types of software. The magnetic disk or diskette commonly used form of software. This diskette may be of the floppy disk type or a hard disk type. In either case, the data is stored on a magnetic disk. Another form of software is magnetic tape or cassette. In the cassette, the computer program is recorded on the cassette and the cassette, in turn, gives commands to the computer.

Handling Software

Software should be maintained in a dust-free file. Cassettes and diskettes are small and can be stored in a plastic container that is smaller than a shoebox. The operator should be careful not to touch the grooved protion (center) of the diskette. This can damage the data stored on the diskette. Common sense will provide direction in software handling. Diskettes must not be bent or have materials piled on them that might damage the disk.

Identification of Software

Software packages should be clearly marked and filed in alphabetical order. This allows the operator to find the proper software quickly. Small labels should be attached to the cardboard diskette holder. The name of the program should be clearly marked on the labels with a black pen. For software that controls the processes of steam generation, the diskettes or cassettes should be labeled by function such as "Start up Boiler" or "Control Steam Temperatures".

Assignment

* Complete the job sheet.
* Complete the self-assessment and check answers.
* Complete the post-assessment and have the instructor check your answers.

Job Sheet

VISIT A COMPUTER STORE

* Visit a local store that sells microcomputers, i.e. Radio Shack, Commodore, IBM.
* Ask to see their software catalog.
* Identify software that is appropriate for use in a power plant.
* Ask salesperson to demonstrate diskette and/or cassette use, care and storage.

Self Assessment

Match the following words and phrases.

____	1. Main frame	A.	Type of magnetic tape
____	2. Diskette	B.	Labels should be attached to this part.
____	3. Cassette	C.	Designed about a micro-processor chip.
____	4. Microcomputer	D.	Central Processing Unit Computer
____	5. Diskette holder	E.	Type of magnetic disc

Self Assessment Answers

D 1.

E 2.

A 3.

C 4.

B 5.

Post Assessment

1. A _____ computer requires a controlled environment and has large memory storage.

2. A _____ is built about a microprocessor chip.

3. List two types of disks.

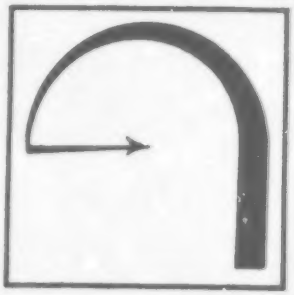
4. What is the common name of magnetic tape software?

5. What is the common name of magnetic disk software?

Instructor Post Assessment Answers

1. Mainframe
2. Microcomputer
3. Floppey, Hard
4. Cassette
5. Diskette

Supplementary References



* Sales literature from computer companies will provide understanding of software terminology and specifications.